

AD 606906

IS WATER DIFFERENT?

J. C. DeHaven
Mathematics Division
The RAND Corporation

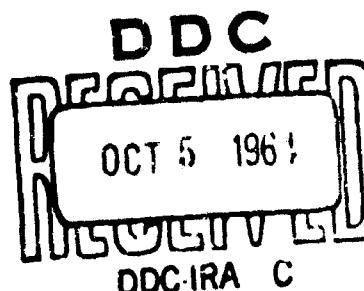
P-1349-RC

Revised
25 May 1960

Approved for OTS release

COPY	18-1
HARD COPY	18-1
MICROFICHE	\$. 75
	\$. 0.50

Reproduced by



The RAND Corporation • Santa Monica • California

The views expressed in this paper are not necessarily those of the Corporation

CLEARINGHOUSE FOR FEDERAL SCIENTIFIC AND TECHNICAL INFORMATION CFSTI
DOCUMENT MANAGEMENT BRANCH 410.11

LIMITATIONS IN REPRODUCTION QUALITY

ACCESSION # 410.666906

- 1. WE REGRET THAT LEGIBILITY OF THIS DOCUMENT IS IN PART UNSATISFACTORY. REPRODUCTION HAS BEEN MADE FROM BEST AVAILABLE COPY.
- 2. A PORTION OF THE ORIGINAL DOCUMENT CONTAINS FINE DETAIL WHICH MAY MAKE READING OF PHOTOCOPY DIFFICULT.
- 3. THE ORIGINAL DOCUMENT CONTAINS COLOR, BUT DISTRIBUTION COPIES ARE AVAILABLE IN BLACK-AND-WHITE REPRODUCTION ONLY.
- 4. THE INITIAL DISTRIBUTION COPIES CONTAIN COLOR WHICH WILL BE SHOWN IN BLACK-AND-WHITE WHEN IT IS NECESSARY TO REPRINT.
- 5. LIMITED SUPPLY ON HAND: WHEN EXHAUSTED, DOCUMENT WILL BE AVAILABLE IN MICROFICHE ONLY.
- 6. LIMITED SUPPLY ON HAND: WHEN EXHAUSTED DOCUMENT WILL NOT BE AVAILABLE.
- 7. DOCUMENT IS AVAILABLE IN MICROFICHE ONLY.
- 8. DOCUMENT AVAILABLE ON LOAN FROM CFSTI (TT DOCUMENTS ONLY).
- 9.

NBS 9/64

PROCESSOR:

IS WATER DIFFERENT?

Some of the water in this tumbler traveled about 1300 miles to reach Los Angeles, originating as snow which fell over a year ago in the central Rocky Mountains. About 240 miles of this distance it was pumped through the man-made aqueduct of the Metropolitan Water District. Without this water brought from the Rockies and that brought about 300 miles by Los Angeles from the Owens Valley in the High Sierras, our present pattern of agricultural and industrial development right or wrong in Southern California would not have been possible.

One often hears the statement made, "Water is different, it makes possible the development of our region." "Water makes the desert bloom even as the rose." We are told that a larger supply is crucial for our continued existence in Southern California and that our regional growth depends upon having even larger supplies available from more distant sources. We hear that our present supply is inadequate to meet our imminent "needs" and "requirements." As responsible citizens, then, we feel, or are told, that we should be concerned with the development of this so-called "priceless" resource.

At the risk of oversimplification, I would like to try first and briefly to present some principles — some ways of thinking about our resources — which may assist your own analysis of local water problems and proposals. Subsequently, I will try to apply these principles in

evaluating the proposal for the inter-regional transfer of water from Northern California via the Feather River Project, which looms large on our horizon.

"Water is different." Without water, you say, human existence is impossible. Without water we would all die of thirst. Well, about one gallon a day per person is essential for minimal human existence. Troops in the field have existed for months at a time on this amount. As living standards increase, we demand more and more water so that at present in the Los Angeles area we demand an average of 170 gallons per day per capita for all purposes — for households, for industry, for agriculture.

But, food is equally important for our survival. Without at least about 1600 calories a day per capita we would eventually starve. The time to die from starvation might be a little longer than from thirst, but the end is equally sure.

Even in beneficent Southern California, a certain amount of fuel is necessary for survival, fuel to keep warm, to cook, to transport goods. Clothing is essential, too. You may get by in Southern California clad in shorts, but you'd better not move to the East in them or you'd freeze to death.

The important point is that a certain minimum amount of many resources is crucial for human survival. These first increments are "priceless" in the same sense as is the first increment of water. Water really isn't different in this way.

Each of our families has a limited capability for purchasing goods and services produced by others. Some of us are just more limited in these means. In modern society, this ability to swap goods and services with others is represented and measured by that neat social invention — money. If we have very little means, we will buy with money or with our own labor at least the minimum survival amounts of food, water, clothing, and fuel. As we produce more goods and services useful to and desired by others, we earn more money and we can buy more or better goods. At any one time, the price we pay for anything represents the combined effects of the desires of others for that same commodity and the supply of it available for sale. With a supply of only one gallon a day of water per head, we will pay a high price for this gallon. In contrast after we have built up our consumption of water to 170 gallons a day per head, we will place a very low value on the 171st gallon and not be willing to pay the same high price for it as we would for the first, or for the fifty-first gallon. With our limited family means, every purchase represents other purchases foregone. Steak tonight means beans and rice next week; a new Cadillac this year — no new mink stole, etc. There are not many things we would rather have than the first gallon of water a day. There are more things we would rather have than the fifty-first gallon a day, and there are just lots and lots of things we would rather have than the 171st gallon of water.

However, you maintain, "Water is different!" If it were not for water for irrigation our western agriculture would be impossible. "The desert would not bloom even as the rose." Think carefully! Just pouring water on the desert doesn't create food and fiber. Inputs of other resources are also essential. Labor, power, fertilizer, seed, tools -- all must be used and combined with water to produce agricultural products. The lack of any of these inputs will cause the failure of a western farm. So, water isn't unique in this respect.

We are told that each new acre irrigated will earn \$200 a year, create new jobs, and thereby contribute significantly to the development of our State. What is overlooked is that a similar size investment elsewhere may actually earn much more and create more jobs than if invested in providing new water for agriculture. Generally these days, agriculture is not willing or can't afford to pay the full costs for providing new irrigation water supply. Consequently, the taxpayers make up the difference in the form of a subsidy. If the money used for this water subsidy were left in the hands of the taxpayers, they could invest it in more profitable enterprises or spend it for commodities other than those produced by the increased irrigation agriculture. We already have so many surplus agricultural crops that they are coming out of our ears. We can't find any more places to store them. We are even having troubles giving them away. With so much of our water development in the hands of local and national government agencies which are subject to

political pressures, we must examine each new water development proposal carefully to assure ourselves that it is not just a disguised plea for increased subsidy by special interest groups.

But, you say, "water is different" in that it must be transported long distances through large, very costly man-made works from other regions. Some of our local water travels 1300 miles! The costs and planning required to obtain new water are beyond the abilities of individuals and private organizations. Besides, we can't have competing water companies with their lines running parallel through our city.

Water isn't really different in these respects, either. For example, private companies have spent over \$6 billion dollars west of the Rockies alone laying new natural gas lines. Some of the gas you burn now comes from El Paso, Texas. Some of it soon will come from Canada. The private corporation is a very efficient device for raising capital and supplying your demands. The wool in your suit may have come from Australia, the bananas and pineapple in your salad from Central America and Hawaii, the tobacco in your cigarette from North Carolina and Turkey, the components of your car from Detroit. All of these commodities being available when and as you wish them without their having been financed and planned for by the Government.

It isn't usually efficient to have parallel gas, telephone, or electric lines serving the same city, either, so, we have firms called public utilities that furnish these services on a monopolistic basis. For your

protection the rates those so-called natural monopolies may charge you are regulated by public bodies. Up until now in Southern California all of our water has been supplied by local public and private utilities. There has been no reason for the State to build and operate a water system as it now proposes.

So far, no unique characteristics of water appear. Indeed, it takes some searching to locate the reasons why the problems of water supply may be different at all from those of other commodities. Why it is that a public organization like the Chamber of Commerce feels called upon to concern itself with water supply more often than with the supply of food, or clothing, or natural gas.

First, water exists partly as a store and partly as a flow with a great interdependence of use so that it has been difficult to extend conventional private property rights to water. Thus, if you own land, you can generally use it or sell it as you see fit. But, if a river flows across your land, you can't use the stream without consideration for the rights of downstream property owners. Similarly, since the beginning of our nation, navigable streams have been under the control of the Federal Government, and could not become private property. Thus, whether we like it or not water has tended to become a common resource in law and therefore a field of activity for local, state, and Federal governments. Under these circumstances, then, it is particularly appropriate for public organizations as well as individuals to concern

themselves with the use made of this resource by Government entities.

The means available to our local, state, and national governments are limited, just as our individual family means are limited. The incomes of these governments, which can be invested or spent comes primarily as taxes from each of us. Governments have no magic fonts of wealth from which spring funds to be spent on developing new water supplies. Each additional expenditure by a government entity in which costs are not returned results in that much less each of us can spend or invest as individuals. In addition, each expenditure on water development by a government body, not recompensed by the users, reduces the amount available for the government to spend for other purposes — on schools, police protection, highways, hospitals, medical research, etc.

Especially, we in California should be interested in carefully examining the so-called "master plan" for redistributing the waters of the State as prepared by the Department of Water Resources, and designated "The California Water Plan." This plan purports to establish areas where "surplus" water will exist in the indefinite future and what areas will be "deficient" in water. It then engineers a massive system of dams and aqueducts to collect the water in the "surplus" areas for distribution to the "deficient" areas. The total costs for this system if constructed would be over 13 billion dollars.

Although the plan states that some of the proposed works may never be feasible and thus not constructed, and that in any event none of the

works should be constructed until they are shown to be economically sound, the State Government nonetheless is pushing for the early construction of the first piece of the plan — The Feather River Project. All this in the face of serious doubt as to the economic and financial feasibility of this 3-billion dollar project and the willingness of the potential customers to buy any of the water at the very high prices which must be charged if the project is to come even close to paying its own way.

One and three quarters billion dollars to start the construction of the Feather River Project are supposed to be obtained from the sale of general obligation bonds which the electorate must approve or disapprove this November. Note that I emphasize that this bond issue if approved (and if sold) will only partially construct this project to deliver northern water to possible consumers in the south. Funds for the construction of Oroville Dam (and possibly other dams) required to firm up deliveries to Southern California are not included in this bond issue, nor are funds provided for the construction of local conveyance lines to distribute the water from the aqueduct to local wholesale agencies. Costs for these necessary features of the project, plus the planned South Bay Aqueduct, will amount to at least another 1.2 billion dollars. Oftentimes the voters will be asked to approve additional state and local bond issues to cover these features in coming years.

This is the most costly water project ever proposed. Is it financially feasible? These days one must first define what he means by the term

"financially feasible." The "old-fashioned" meaning is that the beneficiaries of a project can and will repay the costs of the project with interest. The "modern" meaning is, can bonds be sold to finance the project, given sufficient contribution from the general taxpayer. More specifically, can this amount in bonds be sold and if so will they jeopardize the credit position of the State of California? One of the more unfortunate features of this loose definition of financial feasibility is that it does not relate at all to the economic desirability of a project. On this basis, a proposal to throw a billion silver dollars of taxpayers' money into San Francisco Bay might be financially feasible. It is noteworthy that even by this undiscriminating criterion there is serious doubt as to the financial feasibility of the Feather River Project, and good reasons to believe that the financial position of the State might be placed under severe stress by the projected financial requirements.

Consider the following statement by the Joint Committee on Water Problems of the California Legislature:

The present rate of bond sales will double the State's bonded indebtedness within approximately four years and thus bring it up among the top ranking states in bonded indebtedness per capita. The existing rate of increase in the State's general obligation bond indebtedness is presently reaching problem proportions even without any bonds for water projects.

It thus can be seen that the financial position of the State is not encouraging. Funds for water resources development are being sought at a time when the State has a serious general fund deficiency which does not finance its existing programs. At the same time the State is already placing general obligation bonds on the market at a rate which requires careful management not to depress the market. As the latest program to be added by the State, water resources development stands in an unfavorable position with respect to funds.*

A similar reaction was expressed by the Joint Legislative Tax Committee of the California Legislature which stated that:

In recapitulation, California in the 1959-60 fiscal year finds itself on the brink of one of its most serious fiscal crises. Governmental functions are being carried out only at the cost of an ever widening gap between revenues and expenditures. Available reserves are either dwindling or have been committed so as to leave no hope from this quarter for substantial budgetary aid beyond June, 1959.**

These statements by responsible State authorities indicate that there is serious doubt whether California and its taxpayers can afford this project now, regardless of its economic worth. But, is this project economic? Will its benefits exceed its costs over time? To determine this from the Southern California view, let's look at the unit costs to

* Twelfth Partial Report by the Joint Committee on Water Problems, March 24, 1959, California Legislature, Sacramento, pages 12, 13.

** Report of the Joint Legislative Tax Committee, Senate, State of California, May, 1959, page 40.

deliver water here, based on the State's estimate of the project's construction and operation costs and delivery schedule. We have calculated these unit costs at three discount rates, 3 1/2%, 6%, and 10%. On this basis, the unit costs for untreated water at the aqueduct in Southern California are:

\$ 63 per acre foot at 3 1/2%

\$105 per acre foot at 6%

\$221 per acre foot at 10%.

These figures do not include an estimated cost of \$7 an acre foot for filtration for urban use or an estimated additional \$15 an acre foot for conveyance to agricultural users. We are thus considering the potential sale of water costing at the minimum \$70 to \$78 an acre foot wholesale. A very good case can be made that 6% or even 10% are more appropriate discount rates for a project involving the risks and overoptimistic construction-cost estimates that this one does. Also, these higher discount rates are a better measure of the opportunity value for resources invested in the private sphere. We are, therefore, really considering an increment of water for Southern California which will cost from \$100 to over \$200 an acre foot, wholesale. Will this water sell here even at the optimistic price of \$70 to \$78 an acre foot required to cover costs? I believe the answer is an unqualified no. If this project is constructed now, the taxpayers will be required to pay a huge subsidy representing the difference between the actual cost of the water and the much lower price at which it can be sold.

To obtain an appreciation for this cost-price relationship, let's look at Table I which shows the present sources of supply in this area and their unit costs. The average cost of the Los Angeles supply is about \$6 an acre foot. The highest cost increment in this supply is the 7% obtained from the MWD, which costs \$25 an acre foot treated. Agriculture in the area pays from \$2 to about \$30 an acre foot at the head gate or well. (A few avocado growers in San Diego County pay up to \$90 an acre foot.) The highest retail price to households delivered at the meter is \$74 an acre foot in Los Angeles. Obviously, then, the construction of the Feather River Project into Southern California should be delayed until prices for water in the area rise to the level required to cover the project cost.

Does believing the construction of the Feather River Project is unwise mean we are willing to see the development of Southern California cease and the region return to desert? By no means. The water inputs for further development can be obtained in many alternative ways, through economic reallocations of the present supply from lower to higher valued uses, through increased utilization of our present supply by greater recycling and increased entrainment, and through technological developments. Supplies of water already in use in the area or available from fuller use of the Colorado Aqueduct are sufficient to support at least a 60% increase in population and industry beyond the 1960 level. All this at water prices below the most optimistic Feather River Project costs.

Best Available Copy

Table I
ESTIMATED PRESENT USE OF WATER
SOUTH COASTAL AREA

Water Source	Present Withdrawal for Use (Acre-feet per year)	Approximate Wholesale Cost (\$ per acre-foot)
Local surface and ground water (including estimated net overdraft)	1,218,000	4.50 - 10.00
Imported water		
Los Angeles Aqueduct	320,000	2.00
Colorado River Aqueduct	707,000	12.00 - 25.00 (softened)
Total	2,245,000	

Then, too, there are additional sources of supply for the area which have not been seriously considered by the State planners. Table II shows the possible additional amounts and approximate cost range for these potential additional sources of supply for this region. It appears that at least twice the amount of present withdrawals might be obtained at costs less than for Feather River water. Indeed, it is possible by the time in the future that this region exhausts some of the other sources of water shown in our Table II that technological improvements in sea water conversion units may make this source competitive with Feather River water. There are great uncertainties in the cost estimates for both of these sources.

In conclusion, I hope I have persuaded you that water is not different from other resources in most of the ways it is often discussed. It has no unique, magical properties by itself to create wealth, nor to cause the development of a region. Water is different in that features of its supply, custom, and the development of water law have placed it largely in the public domain. Consequently, the development of new supplies and its distribution is often the responsibility of government agencies. For this reason, special problems arise in the division of the available supply among user categories and between regions. Decisions in these matters are often made in the political arena instead of in the market place as with most other resources. Even so, it is important that the citizen-taxpayer become informed of the economic

Table II.

POSSIBLE ADDITIONAL SOURCES OF SUPPLY
FOR THE SOUTH COASTAL AREA

Source	Annual Amount (Acre-feet)	Estimated Costs per Acre-foot		
		3%	6%	10%
Colorado River Aqueduct	500,000 - 600,000	23, 33	30, 40	43, 53
Additional Local Entrapment	100,000	20-45	34-75	56-126
Reduction in Local Evaporation	50,000	10	10	10
Reclamation of Sewage	350,000 - 500,000	15-30	20-40	25-50
Purchase and Transport from Adjoining Regions				
Owens-Mono	200,000	28	45	74
Kern River	100,000 - 400,000	32	42	59
Colorado River	1,000,000	50	60	80
Feather River Project	1,800,000	63	105	221
Sea Water Conversion	Infinite	200	-	250

Best Available Copy

aspects of water supply. Otherwise, water development decisions by government agencies may result in the wasteful investment of our other resources to produce more water. Large dams and lengthy aqueducts for transferring water between regions are not the only alternative sources of increased water for our region. In fact, they may often be the most costly.